DESTination RAIL NEWS

DESTination Rail Newsletter

Issue number 4
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DESTination Rail Mid Term Review.

Welcome to the fourth issue of our Newsletter. The half way point of the project was reached on 1st October 2016 with the project now moving from the Find and Analyse phases to the Classify and Treat work. This milestone was followed by two important meetings;
The 4th Project Workshop which was held at the Technical University of Munich on November 10 and 11.
The Interim Project Review with the EU Project Officer which was held in Brussels on December 13.

What has been achieved since the launch of DESTination Rail?

The project workshop agenda for the two days included meetings of the Exploitation Sub Committee, Executive Board and Work Package Groups. These meetings provided an opportunity for inter work group and group meetings to discuss current issues, and determine the way forward. The opportunity was taken to review progress of the four main areas of work which formed the input for our meeting with the EU Project Officer. These are summarized below:

- Find - Geophysical techniques have been applied at demonstration sites on the rail networks in Croatia (**Figure 5**) and Norway to locate weak points on the rail track e.g. burrows, weak spots and voids with focussed additional testing continuing. Gavin & Doherty Geosolutions Ltd. (GDG) has applied statistical techniques to historical data on landslides in Ireland to predict the location of the most vulnerable slopes on the Irish rail network (IE). Using field tests NGI have developed an approach for assessing the speed at which high-speed trains cause damage in soft ground areas (**Figure 3**). UZ has used drones to investigate rock and slope stability in Croatia (**Figure 1**) A landmark rail bridge in Ireland was instrumented by UT to measure its dynamic response in addition to one in the Netherlands (**Figure 4**).

In this issue:

(Figure 1)Traditional method of monitoring rock geometry

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- Analyse - New multi-modal techniques have been developed to allow the safety of slopes to a range of hazards to be assessed. Monitoring of the Boyne Bridge and subsequent filtering of the measured data to remove dynamic portions of stress signals, allowing quantification of the Assessment Dynamic Ratio was applied for the first-time to a real railway bridge. A three-dimensional Finite Element model of the Boyne Viaduct has been developed for dynamic simulation. Probabilistic fatigue analysis based on measured data has also been performed for the Boyne Viaduct.

- Classify - Following an extensive review of literature, the development of a draft Information Management System by UT and face to face discussions with infrastructure managers, a schema-less, document based database format has been chosen as the information management system for the project. The development of a high-level web based, decision support tool is well advanced. The graphical user interface has been established. This allows GIS based visualisation and selection of railway objects. Multi-criteria and multi-objective decision analysis can be undertaken at levels varying from an object to a network level.

- Treat - Laboratory testing of innovative light-weight fill materials has been performed by ZAG and NGI to develop constitutive models for these materials. A fully-instrumented Geosynthetic Reinforced Soil (GRS) system has been demonstrated in Slovenia (**Figure 2**). In the same area high-pressure grouting using novel polyurethane resins has been undertaken to strengthen marginal soils. A traffic flow model has been developed by OTRT for the Malahide to Dundalk line of Irish Rail.

Figure 2. Injecting polyurethane resin on the approach to the Dolgi Most bridge in Slovenia, the expansion of the resin results in an increase in the confining pressure & leads to increased stiffness

This work has been supported by the production of a number of project documents alongside the publishing of Scientific Papers, see table A, with presentations being given at selected conferences across Europe. The following reports are in the process of being made available on the project website www.DESTinationRail.eu

- Report on Common Problems faced by Rail Infrastructure Managers
- Guideline on methods to find “Hot Spots” on rail networks
- Report on Risk Assessment Methodology

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Table A. List of Published Articles

Title of the Article/Paper	Authors	Title of Journal/Magazine	Date of Publication
DESTination Rail Application of Unmanned Aerial System (UAS) in Railway Infrastructure	Marijan Car, Danijela Juric Kacunic, Michael Robson	Railway Pro	11/2016
Application of Unmanned Aerial Vehicles on Transport Infrastructure	Danijel Juric Kacunic, Lovorka Liberic, Marijan Car	Gradevinar	05/2016
DESTination Rail overview	Michael Robson	European Railway Review	07/2016
Development of a Vehicle-Bridge- Soil Dynamic Interaction Model for Scour Damage Modelling	Luke J Prendergast, David Hester, Kenneth Gavin	Shock and Vibration, Hindaw Publishing Corp	01/2016
System Reliability of Slopes Using Multimodal Optimisation	Cormac Reale, Jianfeng Xue, Kenneth Gavin	Volume 66, Issue 5 - ICE Publishing	01/2016
Use of Risk Assessment Frameworks for the Management of Transport Infrastructure Slopes in Europe	Kenneth Hgavin, Karlo Martinovic, Cormac Reale, Mario Bacic plus 15 others	Ecole des Ponts Paris	09/2016
Assessing the Vulnerability of Irish Rail Network	Karlo Matinovic, Kenneth Gavin, Cormac Reale	Transportation Research Procedia Vol. 14 2016	04/2016
Multi Modal Reliability Analysis of Slope Stability	Cormac Reale, Kenneth Gavin, Luke J. Prendergast Jianfeng Xue	Transportation Research Procedia Vol. 14 2016	04/2016
Development of Landslide Susceptibility Assessment for a Rail Network	Karlo Martinovic, Kenneth Gavin, Cormac Reale	Engineering Geology Vol. 215 - 2016	09/2015
DESTination Rail DST	Andreas Schoebel	ETR, Austria	09/2015

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Table A List of Published Articles

Title of Article/Paper	Author	Title of Journal/Magazine	Date of Publication
Detection of Acceleration Sensitive Areas of Rail Using a Dynamic Analysis	Cai Xiaopei, Kassa Elias	3rd International Conference on Railway Technology: Research Development and Maintenance	2016
Risk Assessment Process for Railway Networks with a focus on Infrastructure Objects	N. Papathanasiou, R. Adey, C. Martani	1st Asian Conference on Railway Infrastructure and Transportation	2016
A Review of the State of the Art in Railway Risk Management	N. Papathanasiou, R. Adey, C. Martani	1st Asian Conference on Railway Infrastructure and Transportation	2016
Calculation of the Dynamic Allowance for Railway Bridges from Direct Measurement	Lorcan Connolly, Donya Hajializadeh, Cathal Leahy, Alan O'Connor, Eugene O'Brien	Proceedings of the 3rd International Conference on Railway Technology: Research, Development and Maintenance, UK	2016
Probabilistic Modelling and Assessment of Railway Bridges	Lorcan Connolly, Alan O'Connor, Eugene O'Brien	Proceedings of the 8th International Conference on Bridge Maintenance, Safety and Management, Brazil	2016
Monitoring and Maintenance of the Boyne Viaduct	Lorcan Connolly Alan O'Connor Cathal Bowe	Proceedings of the Civil Engineering Research in Ireland Conference	2016
Use of Structural Health Monitoring for Maintenance of the Boyne Viaduct	Lorcan Connolly	Proceedings of the MOSTY International Bridge Symposium, Brno	2016

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What will DESTination Rail deliver in the next 18 Months?

The next 18 months will see the project move into the last phase of results. These will include under the four main headings;

- Find - The use of drones to analyses rock and soil slopes has proven to be much more effective in terms of data collections, cheaper and safer than traditional inspection methods and will be further exploited in Croatia.
- Analyse - Methods used to update the statistical distributions used in Infrastructure assessment have been extended to the application of multi-modal probabilistic distributions to reliability assessment and particle-swarm-based techniques while considering monitoring data for slope stability analysis. The filtered monitoring data from the Boyne Viaduct suggest that dynamic effects are less than 5% of the values suggested in current design codes with work continuing.
- Classify - The framework for the multi-asset decision support tool has been created and will be demonstrated on a central portion of the Irish Rail network in Central Dublin. A Webinar and workshop will be held to demonstrate the use of the tool to a wider audience.
- Treat - A number of novel materials and remediation techniques have been demonstrated on live railway lines in Slovenia aimed at reducing disruption, increasing safety and minimising the effect on the environment. The results of this work will be examined to see if the methods are effective.

Figure 3. Smart wireless sensors fitted to the track in Norway

Figure 4. Structural health monitoring of a rail bridge in the Netherlands

In addition to the above a number of Guidelines on how to implement the results will be produced for the final DESTination Rail conference. A number of reports covering results of the research will also be produced which along with the report of the final conference will be available on the DESTination Rail website **www.DESTinationRail.eu**

These will include :

- Report on the Use of Remote Monitoring for Slope Stability Assessments
- Report on the Monitoring of Switches and Crossings
- Report on the Implementation of Complete Vibration Monitoring System on an Irish Rail Bridge
- Report on the Assessment of Bridges
- Report on the Assessment of Earthworks
- Report on the Assessment of Tracks
- Report on the Decision Support Tool
- Report on the Whole Life Cycle Analysis Tool.

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How Ph.D. Students are Contributing to the Project.

As part of the DESTination Rail proposal, the project committed to taking on a number of Ph.D. students in order to develop research capabilities. With this in mind a number of students have prepared articles describing how they are working with the project to try and encourage more students to join this area of research. This is the third article and features Marijan Car who is studying at The Faculty of Engineering, Zagreb University and working on tasks 1.2,1.3 and 1.4

Name: Marijan Car.
University of Zagreb, Faculty of Engineering.
Department of Geotechnical Engineering.
Email: mcar@grad.hz

As a Ph.D. student at Faculty of Geodesy, University of Zagreb I was very honoured to join the DESTination RAIL project. My main research is in the domain of UAS (Unmanned Aerial Systems) and digital Photogrammetry as applied to railway and railway infrastructure under the supervision of assistant professor Dubravko Gajski from the Faculty of Geodesy and Professor Meho Sasa Kovacevic from Faculty of Civil Engineering. In June 2016 the senate of the University of Zagreb approved my dissertation theme under the name “Development of procedures for determination of railway embankment movements using Unmanned Aerial Systems”.

The idea behind the “FACT” principle (Find – Analyze – Classify – Treat) on which the project is based is to develop a tool that will enable persons responsible for the operation of railway infrastructure to distribute more appropriately the funding needed for the rehabilitation of such infrastructure. The University of Zagreb is involved in three work packages, 1, 3 and 5. For me the most interesting part in DESTination RAIL project is work package 1. The main objective of this WP is to locate and identify risky assets before they fail using a combination of remote monitoring and expert judgement including the use of UAS to remotely monitor the condition of soil or rock slopes.

Standard visual assessments usually consist of personnel walking along the line being examined. For some assets, for example high or steep slopes, important information (such as land use changes at the crest, the condition of drains and presence of cracks etc.) often cannot be seen. Unmanned Aerial Systems fitted with high-resolution cameras will enable a more detailed inspection to be carried out. UAS can also be equipped with various different types of sensor like GPS (Global Positioning System), mobile LIDAR system (Light Detection and Ranging), thermal cameras, multispectral cameras or even gas detectors. Through the application of such sensors attached to UAS it is possible to monitor and create 3D models of hotspots along the track that can provide cross sections (**Figure A**), volume determinations, contour lines and other parameters that are needed for engineering analyses.

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Despite the evident advantages of Unmanned Aerial Systems some limitations do exist, such as bylaws in some countries regulating the use of unmanned aerial vehicles and also different weather conditions like rain, strong wind and snow, which can cause disruption to flight missions.

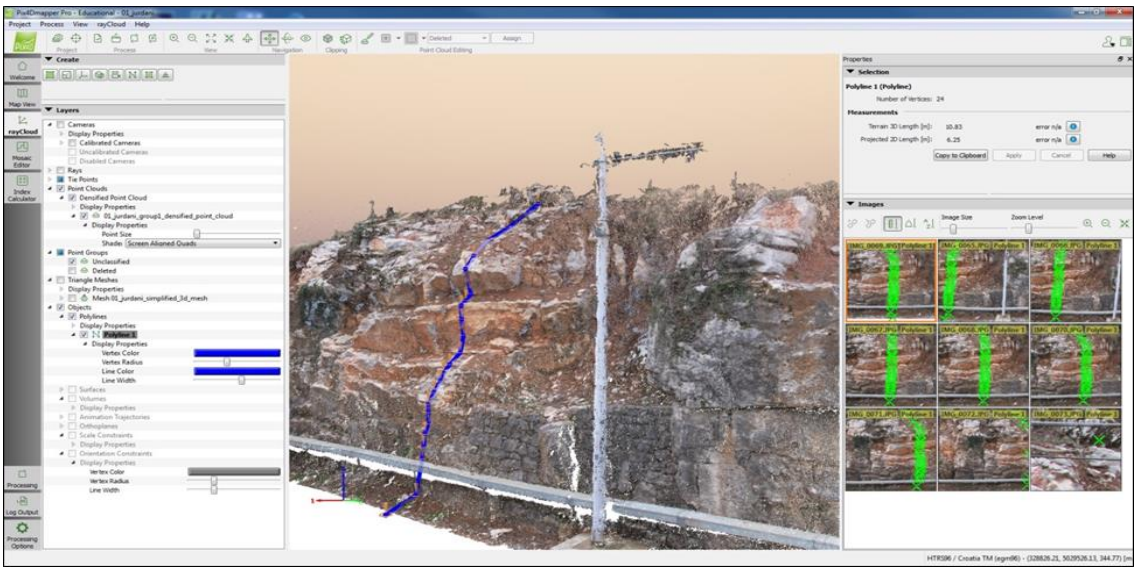

Figure A. Example of a 3D Model and cross section generated from pictures taken using an UAS

Another part of WP 1 which involves the University of Zagreb is Ground Penetrating Radar (GPR) which implies collecting data using a custom made cart driven along the track. A range of antennae with different frequencies are used to provide a complete three-dimensional image of the obtained section. This will allow detection of anomalies such as ballast pockets due to depression, animal burrows and the distribution of water content.

One more hotspot of WP 1 are tunnels, which are critical elements of all railway infrastructure. Inspection through LIDAR, GPR and SASW (Spectral Analysis of Surface Waves) were carried out in Croatia to provide the best insight into tunnel conditions.

The DESTination RAIL project involves fifteen partners from nine European countries including research institutions, small and medium-size enterprises, consulting companies and institutions in charge of railway operation. As a Ph.D. student this is huge opportunity for me to meet, learn from and talk to numerus experts from other countries, and to help develop a tool that will be most helpful for infrastructure managers.

Figure 5. Two examples of Railway Infrastructure Assets where GPR has been used to establish the ballast and track bed conditions

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How to Follow DESTination Rail Progress

There are a number of ways in which one can follow the progress of the DESTination Rail project;

- By searching our website **www.DESTinationRail.eu**. where you will find copies of all our newsletters, presentations given at conferences along with copies of all the reports and guidelines produced by the team.

- Why not join our linked in group www.linkedin.com/groups/8428750 where you can participate in discussions on the project?
- You can contact us directly via either the Project Co-ordination Prof. Ken Gavin kgavin@gdgeo.com or the Project Administrative Manager Mrs Carla Soriano cmarina@gdgeo.com or by telephoning the Project Office on 00 353 1207 1000.
- If you would like to receive our Newsletter directly then please email your name, company and position to Michael Robson maralnwick@yahoo.co.uk who will add your name to the distribution list.
- We make regular presentations at conferences across Europe which provide an opportunity to meet members of the team (Figure 6). We plan to give presentations at the following conferences over the next 6 months;

International Railway Forum and Conference, Prague 22/23/24 March 2017
Railway Pro Technical Services Forum, Arad, 5/6 April 2017
International Bridge Symposium (MOSTY), Brno 27/28 April 2017
Scandinavian Rail Development, Stockholm 22/23 May 2017

In addition a member of the DESTination Rail team will be attending the International Transport Forum from 31 May to 2 June 2017 in Leipzig.

Figure 6. showing presentations being given at CETRA in May 2016 and the Railway Pro conference in Bucharest in October 2016

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